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ABSTRACT

In Mississippi, the State College Board has increased college entrance requirements in science for four-year universities to include three science courses consisting of biology, chemistry, physics, or advanced courses in these areas. This has had the immediate effect of doubling the science enrollment in some high schools. This study was designed to examine this new enrollment, to classify the students as to type of locus of control (internal or external), and to analyze the effects of locus of control upon achievement in chemistry. The results of the study indicated that there was no significant relationship between locus of control and achievement. However, there was a significant interaction between gender and locus of control with regard to achievement. This finding indicates that external males score higher in achievement than internal males. Although the results for females were similar, the interaction was not significant. (TW)

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The Effect of Locus of Control on Achievement in Chemistry

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A Paper Presented at the Annual Meeting of the Mid-South Educational Research Association, November, 1987.

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The Effect of Locus of Control on Achievement in Chemistry

Problem

In the recent push for excellence in education, many programs at the state and local levels have been faced with increasing graduation or college entrance requirements. In Mississippi, the State College Board has increased college entrance requirements in science for four year universities to include three science courses consisting of biology, chemistry, physics, or advanced courses in these areas (College Board Release, 1984). This had the immediate effect of doubling the science enrollment in some high schools for biology, chemistry, and physics. The ruling virtually abandoned a nonlaboratory physical science course which had been taught at the ninth grade level. This had the effect of placing some students in each of the new courses one year early. The new enrollment in chemistry classes doubled old enrollments and included more females, more blacks, and more sophomores. Previously, high school chemistry classes had a goal of preparing students to take college chemistry in pursuit of some scientific career. Many new students had no interest in taking college chemistry but were taking chemistry for the purpose of meeting college entrance requirements (enrollment data and personal interviews).

It was the purpose of this study to examine this new enrollment, to classify the students as to type of locus of control, and to analyze the effects of locus of control upon achievement in chemistry.

The rationale for this study was that the changes in enrollment in Mississippi chemistry classes have produced a more heterogeneous group

of chemistry students. Many students appear to lack the motivation, skills, background, and ability to achieve success in chemistry. The locus of control was identified by Rotter in 1966 as a generalized expectancy that obtaining reinforcement depends primarily upon one's own efforts. A student with internal control believes that he can achieve his own goals. A student with external locus of control believes that his achievement is determined by luck or other people. This study is one of several hundred involving locus of control, but few related locus of control specifically to a high school science course, and none to chemistry.

Literature Review

There have been several thousand studies on locus of control since Rotter introduced the concept in 1966. Most of these studies found some connection between locus of control and achievement. Researchers have hypothesized that subjects with internal control expectancies will achieve higher performance than those students with external control expectancies. There are some inconsistencies as reported by Ronald Brown (1980) who found locus of control related to achievement for normal adolescents only. Noicki (1971) reported that locus of control is related to academic achievement for academic achievement independent of intelligence. Timothy Keith (1985) used a path model with variables of race, family background, intellectual ability, self-concept, locus of control, and achievement. His findings suggest an impact of locus of control on achievement and that a program to produce more internal locus of control will have a positive impact on achievement. In the area of

science achievement, Burkman and Brezlin (1981) incorporated locus of control in their study of the ISIS method, but disregarded it as a variable. Daniel Bar-Tal (1978) found the structure of the environment affects the perception of locus of control in the ISIS program. Sherris (1981) related the degree of concept-relatedness and locus of control in biology classes. In this study, the externally oriented students performed better in the experimental group, but the internal group did equally well in either group. Tobin (1980) has related the formal reasoning ability with locus of control. Gemmill (1982) has related locus of control with the number of math courses a student plans to take. The number of math courses is related to the success in the higher science courses.

Hypotheses

The first hypothesis of this study was that there will be no significant difference in the mean achievement scores in chemistry on the American Chemical Society-NSTA Achievement in Chemistry test between students who have internal locus of control and those who have external locus of control as determined by the Rotter I-E scale of locus of control. A second hypothesis was that there will be no significant differences in subgroup means when the interaction of gender X locus of control is considered relative to achievement.

Limitations and Assumptions

The students used in the study were an intact group of chemistry students in a university town having been randomly assigned to chemistry classrooms. Because of random assignment, the researcher assumed the

students assigned to each class were representative of the school chemistry population.

Definitions

A student with internal locus of control was a student scoring one standard error or below on the mean of the Rotter Scale. A student with external locus of control was a student scoring one standard error or above on the mean of the Rotter Scale. Achievement in chemistry was measured on the American Chemical Society-NSTA High School Chemistry Achievement Test.

Sample

The population for this study was nine intact classes of students taking chemistry at Starkville High School. Students were randomly assigned to nine classes; five were assigned to one teacher, and four to another teacher. The sample for the experiment was the 103 high school students assigned to five chemistry classes under one experienced teacher. Starkville High School is a large comprehensive high school in a university town in Mississippi. About 1/3 to 1/2 of the students were children of college faculty and personnel. The population included 50 males and 53 females. Eighty students were white, 16 were black, and 7 were of non-American origins.

Instruments

The instrument used to classify students on locus of control was the Rotter I-E scale. It is a 29 item, forced-choice test including six filler items. The filler items are used to conceal the purpose of the

test. Internal consistency, as determined by the Kuder-Richardson Test measures, is .69-.76. Test-retest reliability varies from .60 to .83 in one month repeat testings.

Chemistry achievement was measured by the American Chemical Society-National Science Teachers Association Examination in High School Chemistry (form 1983). It is a two part test of 80 items. Each part has multiple choice responses with equal validity for each part, but higher reliability is obtained if both sections are administered together.

The locus of control inventory was administered in April of 1986 by the classroom teacher. The chemistry test was also administered by the classroom teacher in April of 1986.

The subjects were taught by a traditional teaching method for the entire school year using the textbook, Chemistry: A Modern Course. About 10% of the instruction for the course was based on laboratory-demonstration activities.

The method for statistical analysis was the 2 X 2 factorial analysis of variance. It was used to measure the differences in achievement in chemistry associated with locus of control and gender.

Results

Due to absenteeism and school trips, the actual sample size that completed both instruments was 84. Of this number, 42 were males, 42 were females, 14 were black, 64 were white, and 6 were of non-American origin.

The mean locus of control for all 84 students was determined to be

9.976 with a standard error of .438. This was used to determine group membership for the internal and external locus of control groups. Thirty eight students were classified as having internal locus of control, and 46 students were classified as having external locus of control.

The relationship of locus of control and achievement is presented in Table 1.

Table 1

Comparison of Achievement Between Internal and External Locus of Control Groups

Groups	N	Mean	Standard Deviation	F ratio	Sign.
Internal	38	25.7368	7.6217	.836	.3631
External	46	27.4565	9.2897		
Total	84	26.6786	8.5689		

Based on the F ratio of .836 presented in Table 1, the null hypothesis that there will be no significant difference in the mean achievement scores of the students classified as internal and external locus of control cannot be rejected.

A 2 X 2 Factorial Analysis of Variance model was used to assess the relationship between locus of control and gender to achievement. Results of this analysis are presented in Table 2. Table 3 shows a summary of the adjusted means.

The results show a significant interaction between locus of control and gender at the .05 significance level.

Table 2

Results of 2 X 2 Factorial ANOVA for Relating Locus of Control and Gender to Achievement

Sources of Variation	df	Mean Square	F	Sign.
Main Effects				
Locus of Control	1	37.242	.586	.446
Sex	1	614.854	9.678	.003*
Interaction	1	335.328	5.278	.024
Locus of Control X Gender	1	335.328	5.278	.024*
Residual	80	63.532		
Total	83	73.426		

*Significant at .05 level

Table 3

Comparison of Achievement for Internal and External Students Summarized According to Sex

Groups	Adjusted Means
Internal Males	28.60
Internal Females	23.17
External Males	29.94
External Females	24.51

To determine the direction of the interaction, a simple effects test was done. The results for male students show a significant relationship at the .01 level. Male students with external locus of control scored higher on the chemistry test than did male students with an internal locus of control. These results are shown in Table 4 and Table 5.

Table 4

Simple Effects Test Relating Locus of Control to Achievement for Male Students

Sources	df	Sum of Squares	Mean Squares	$\bar{X}$	F Ratio	Sign.
Between Groups	1	296.4354	296.4353	Internal 26.5	3.724	.0606
Within Groups	41	3263.6110	79.6003	External 31.8		
Total	42	3560.0464				

Table 5

Simple Effects Test Relating Locus of Control and Gender to Achievement for Females Students

Sources	df	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	1	76.1339	76.1339	1.632	.2089
Within Groups	39	1818.9881	46.6407		
Total	40	1895.1219			

(table continues)

Group	Count	Mean	Standard Deviation	Standard Error
Internal	20	25.2500	7.0924	1.5859
External	21	22.5238	6.5698	1.4336
Total	41	28.8537	6.8832	1.0750

Conclusions

The results indicate that there is no significant relationship between locus of control and achievement, so the null hypothesis cannot be rejected.

There was a significant interaction between gender and locus of control in regard to achievement. This finding indicates that external males score higher in achievement than do internal males. The interaction for females was not significant, but the results indicate internal females score higher than external females.

The results do not follow the trends established in the review but might be explained due to the unique population. Locus of control appears to interact with gender in regard to achievement in chemistry for males. A further study is planned with other variables considered in the interaction.

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